PATENT
Attorney docket No.: P55890A

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of:

SUNG-KOOG OH et al.

Serial No .: *To be Assigned* Examiner: *To be Assigned*

Filed: 31 January 2002 Art Unit: *To be Assigned*

For: OPTICAL FIBER PREFORM MANUFACTURING METHOD FOR SHRINKAGE AND CLOSING OF DEPOSITED TUBE (As Amended)

PRELIMINARY AMENDMENT

Assistant Commissioner
for Patents
Washington, D.C. 20231

Sir:

Entry of the following preliminary amendments prior to examination and fee calculation of the filing fee for this above-referenced divisional application is respectfully requested. A response to Paper No. 6 dated 30 November 2001 in the parent application serial No. 09/457,392 is due on 28 February 2002.

Folio: P55890A
Date: 1/31/02
I.D.: REB/JHP/sb

CLEAN VERSION OF AMENDMENTS

IN THE TITLE

Please change the title, to read as follows:

-- OPTICAL FIBER PREFORM MANUFACTURING METHOD FOR SHRINKAGE AND CLOSING OF DEPOSITED TUBE --.

IN THE SPECIFICATION

1. On page 1, underneath the title, before the Claim of Priority section, please insert the following paragraph:

-- CROSS-REFERENCE TO RELATED APPLICATIONS

This application is a divisional application of U.S. Patent Application Serial No. 09/457,392 filed on 9 December 1999. This related application is relied on and incorporated herein by references in its entirety.--

2. Please amend the paragraph bridging page 8 and 9, from line 12 on page 8 through line 8 on page 9, to read as follows:

Fig. 1 is a view illustrating a deposition apparatus suitable for an MCVD process. This deposition apparatus is used to deposit a reaction product of raw material gas in the inner surface of

a preform tube. Referring to Fig. 1, a lathe 11 is illustrated which serves to support a preform tube 12. A heating means 14 heats partially the preform tube 12 when viewed in both the longitudinal and circumferential directions of the preform tube 12. In Fig. 1, the region where the preform tube is heated is denoted by the reference numeral 13. The preform tube 12 rotates in a direction, for example, the direction indicated by the arrow 15a in Fig. 1. The heating means 14 moves on track 16 in directions indicated by the arrows 15b in Fig. 1 in accordance with the operation of a moving member (not shown). Accordingly, the heating region 13 is defined while not only moving along the entire length of the preform tube 12, but also rotating around the circumference of the preform tube 12. Raw material gas is introduced from a raw material gas supply unit 19 into the preform tube 12 via an input tube 17. The raw material gas supply unit 19 contains a reactant of a liquid phase therein and supplies this reactant to the preform tube 12 using carriage gas. Exhaust materials are discharged from the preform tube 12 through an outlet 18. The flow rate of the raw material gas is controlled by a mixing valve (not shown) and a shutoff valve (not shown).

3. Please amend the paragraph bridging page 11 and 12, from line 8 on page 11 through line 1 on page 12, to read as follows:

The optical fiber preform manufacturing apparatus also includes a control unit not shown. The control unit performs control operations for the processes of shrinking and closing the deposited tube 20b. That is, the control unit sets the heating temperature of the circular heater 24 to a desired temperature, and rotates the deposited tube 20b supported between the upper and lower support members 22 and 23 at a desired speed while vertically moving the circular heater 24. The heating

temperature of the circular heater 24 is first adjusted to be lower than the softening point of the deposited tube 20b. In this state, the circular heater 24 is moved at a desired speed. During the movement of the circular heater 24, contaminants existing in the deposited tube 20b are then exhausted in accordance with an operation of the vacuum pump 27. Thereafter, the heating temperature of the circular heater 24 is adjusted again so that it is not lower than the softening point of the deposited tube 20b. In this state, the processes of shrinking and closing the deposited tube 20b is carried out. Where a furnace is used for the circular heater 24, inert gas such as argon or nitrogen is supplied to the furnace in order to prevent an oxidation thereof at a heat generating region.

4. Please amend the paragraph bridging page 12 and 13, from line 10 on page 12 through line 8 on page 13, to read as follows:

In accordance with this method, a clad layer and a core layer are first deposited on the inner surface of a preform tube horizontally arranged, using the apparatus shown in Fig. 1, thereby forming a deposited tube (Step 31). Thereafter, the deposited tube is locally heated at one end thereof corresponding to a region where chemical raw gas is exhausted during the deposition process, thereby causing the end to be sealed (Step 32). A rod is horizontally joined to the sealed end of the deposited tube (Step 33). The rod-joined deposited tube is separated from the lathe, and then fed to the tube shrinking/closing lathe shown in Fig. 2. In the tube shrinking/closing lathe, the deposited tube is then vertically arranged in such a fashion that it extends vertically through the circular heater while the rod is upwardly directed (Step 34). Subsequently, the circular heater is moved to the joint between the deposited tube and rod. The heating temperature of the circular

heater is then adjusted so that it is lower than the softening point of the deposited tube. In this state, the circular heater is upwardly and downwardly moved at a low speed to heat the deposited tube. The chlorine gas injector supplies chlorine gas to the deposited tube through the lower support member of the lathe in order to remove moisture existing in the deposited tube. At the same time, the vacuum exhaust value is opened to remove contaminants, including moisture, from the interior of the deposited tube (Step 36).

IN THE CLAIMS

Please delete claims 1-8 and 14-17 without prejudice and disclaimer, amend claims 9 through 13, 18, 22, 24 and 25, and add new claims 26 through 33, to read as follows:

9. (Amended) A method for manufacturing an optical fiber preform, comprising the steps of:

depositing a clad layer and a core layer on an inner surface of a preform tube, thereby forming a deposited tube;

shrinking one end of the deposited tube, thereby sealing the one end of the deposited tube;

arranging the deposited tube in such a fashion that it extends vertically through a circular heater;

moving the circular heater to said one end of the deposited tube, and then adjusting a heating

temperature of the circular heater to be not lower than a softening point of the deposited tube; and

shrinking and closing the deposited tube by heating the deposited tube while moving the circular heater at a desired speed.

10.(Amended) The method according to claim 9, further comprising the step of:

after the arranging step, removing a contaminant existing in an interior of the deposited tube.

11.(Amended) The method according to claim 9, wherein the shrinking and closing step is carried out under the condition in which the deposited tube rotates around its cylindrical axis, and an interior of the deposited tube is maintained at a negative pressure.

12.(Amended) The method according to claim 9, wherein the circular heater is a furnace, and inert gas is supplied to the furnace to prevent an oxidation of the furnace at a heat generating region.

13.(Amended) The method according to claim 9, wherein the shrinking and closing step further comprises the step of removing a moisture in an interior of the deposited tube.

18.(amended) A method for manufacturing an optical fiber preform, comprising the steps of:

preparing a deposited tube by depositing a clad layer and a core layer on an inner surface of a horizontally arranged preform tube;

sealing one end of the deposited tube;

attaching a rod to said one end of the deposited tube;

arranging the rod-joined deposited tube vertically and arranging a circular heater around the tube;

removing a contaminant from an interior of the deposited tube;

placing the circular heater above said one end of the deposited tube and adjusting a temperature of the circular heater to a temperature not lower than a softening point of the deposited tube and maintaining this temperature until the temperature is stabilized;

applying negative pressure to the interior of the deposited tube using a vacuum pump; and

shrinking the deposited tube while rotating the deposited tube and moving the circular heater from said one end to an unsealed end of the deposited tube simultaneously with the applying step.

22.(Amended) The method of claim 18, wherein the circular heater comprises a furnace.

24.(Amended) The method of claim 18, wherein the removing step further comprises the steps of:

moving the circular heater to the one end of the deposited tube, and then adjusting the heating temperature of the circular heater to be lower than a softening point of the deposited tube; and

heating the deposited tube while moving the circular heater at a desired speed, thereby exhausting contaminants existing in the interior of the deposited tube.

25.(Amended) The method of claim 18, said step of shrinking the circular heater further comprising:

injecting chlorine gas into the deposited tube.

--26. A method for manufacturing an optical fiber preform, comprising the steps of:

depositing a clad layer and a core layer on an inner surface of a preform tube in a horizontal lathe, thereby forming a deposited tube;

shrinking one end of the deposited tube, thereby sealing the one end of the deposited tube;

attaching a rod to said one end of the deposited tube;

separating the deposited tube attached to said rod from said horizontal lathe;

mounting the deposited tube attached to said rod in a vertical lathe in such a fashion that it extends vertically through a circular heater;

placing the circular heater around said one end of the deposited tube;

setting a heating temperature of the circular heater to a first heating temperature which is not lower than the softening point of the deposited tube;

heating the deposited tube while moving the circular heater with said first heating temperature from said one end of the deposited tube to an unsealed end of the deposited tube at a desired speed while applying negative pressure to a hollow of the deposited tube;

moving the circular heater from said unsealed end to said one end of the deposited tube;

setting a heating temperature of the circular heater to a second heating temperature which is lower than the softening point of the deposited tube;

maintaining said temperature until said temperature is stabilized; and

shrinking the deposited tube by moving the circular heater with said second heating temperature from said one end to said unsealed end of the deposited tube at a desired speed while applying negative pressure to said hollow of the deposited tube.

--27. The method according to claim 26, wherein the desired speed in the heating step is in the range of 20 to 40 mm/min.

--28. The method according to claim 26, further comprising the step of removing moisture generated in the interior of the deposited tube due to heat of the circular heater.

--29. The method according to claim 28, wherein the step of removing moisture further comprises the step of supplying chlorine gas to said hollow of the deposited tube.

--30. The method according to claim 26, further comprising the step of rotating the deposited tube about its cylindrical axis simultaneously with the step of shrinking.

--31. The method according to claim 26, further comprising the step of:

repeating the step of shrinking.

--32. The method according to claim 10, wherein the step of removing further comprises the steps of:

placing the circular heater to the one end of the deposited tube, and then adjusting the heating temperature of the circular heater to be lower than the softening point of the deposited tube; and

heating the deposited tube while moving the circular heater at a desired speed, thereby exhausting contaminants existing in the interior of the deposited tube.

--33. The method according to claim 13, wherein the step of removing a moisture further comprises the step of supplying chlorine gas to the interior of the deposited tube.

REMARKS

Prior to examination on the merits on this divisional application, Applicants respectfully request entry and consideration of this Preliminary Amendment.

The title has been changed to be more clearly indicative of the invention to which the claims are directed.

The specification is modified to identify the application as a divisional application.

The specification has been corrected at page 8, line 17 to refer to "preform tube" as "12". The specification has been corrected at page 11, line 12 to correlate with other sections of the specification. No new matter has been added. The specification has already disclosed that the circular heater is vertically movable. (*e.g.*, the specification reads on page 11, line 4 that "[t]he circular heater 24 is movable vertically...". The specification has been also corrected at page 12, line 16 to match with the pertinent drawing number.

Claims 1-8 and 14-17 have been deleted without prejudice and disclaimer by this amendment. Claims 9-13 and 18, 22, 24 and 25 have been amended by this Amendment so as to alternatively define the invention disclosed in this application. Claims 26 through 33 have been newly added. No new matter has been added by this Preliminary Amendment.

An early and favorable action is solicited.

Respectfully submitted,

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Folio: P55890A
Date: 31 January 2002
I.D.: REB/JHP

VERSION WITH MARKINGS TO SHOW CHANGES MADE

IN THE TITLE

Please change the title, as follows:

-- OPTICAL FIBER PREFORM MANUFACTURING [APPARATUS AND] METHOD FOR SHRINKAGE AND CLOSING OF DEPOSITED TUBE --.

IN THE SPECIFICATION

1. On page 1, underneath the title, before the Claim of Priority section, please insert the following paragraph:

CROSS-REFERENCE TO RELATED APPLICATIONS

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Fig. 1 is a view illustrating a deposition apparatus suitable for an MCVD process. This deposition apparatus is used to deposit a reaction product of raw material gas in the inner surface of a preform tube. Referring to Fig. 1, a lathe 11 is illustrated which serves to support a preform tube 12. A heating means 14 heats partially the preform tube 12 when viewed in both the longitudinal and circumferential directions of the preform tube 12. In Fig. 1, the region where the preform tube is heated is denoted by the reference numeral 13. The preform tube [2] 12 rotates in a direction, for example, the direction indicated by the arrow 15a in Fig. 1. The heating means 14 moves on track 16 in directions indicated by the arrows 15b in Fig. 1 in accordance with the operation of a moving member (not shown). Accordingly, the heating region 13 is defined while not only moving along the entire length of the preform tube 12, but also rotating around the circumference of the preform tube 12. Raw material gas is introduced from a raw material gas supply unit 19 into the preform tube 12 via an input tube 17. The raw material gas supply unit 19 contains a reactant of a liquid phase therein and supplies this reactant to the preform tube 12 using carriage gas. Exhaust materials are discharged from the preform tube 12 through an outlet 18. The flow rate of the raw material gas is controlled by a mixing valve (not shown) and a shutoff valve (not shown).

3. Please amend the paragraph bridging page 11 and 12, from line 8 on page 11 through line 1 on page 12, as follows:

The optical fiber preform manufacturing apparatus also includes a control unit not shown. The control unit performs control operations for the processes of shrinking and closing the deposited

tube 20b. That is, the control unit sets the heating temperature of the circular heater 24 to a desired temperature, and rotates the deposited tube 20b supported between the upper and lower support members 22 and 23 at a desired speed while vertically moving [the deposited tube 20b] the circular heater 24. The heating temperature of the circular heater 24 is first adjusted to be lower than the softening point of the deposited tube 20b. In this state, the circular heater 24 is moved at a desired speed. During the movement of the circular heater 24, contaminants existing in the deposited tube 20b are then exhausted in accordance with an operation of the vacuum pump 27. Thereafter, the heating temperature of the circular heater 24 is adjusted again so that it is not lower than the softening point of the deposited tube 20b. In this state, the processes of shrinking and closing the deposited tube 20b is carried out. Where a furnace is used for the circular heater 24, inert gas such as argon or nitrogen is supplied to the furnace in order to prevent an oxidation thereof at a heat generating region.

4. Please amend the paragraph bridging page 12 and 13, from line 10 on page 12 through line 8 on page 13, as follows:

In accordance with this method, a clad layer and a core layer are first deposited on the inner surface of a preform tube horizontally arranged, using the apparatus shown in Fig. 1, thereby forming a deposited tube (Step 31). Thereafter, the deposited tube is locally heated at one end thereof corresponding to a region where chemical raw gas is exhausted during the deposition process, thereby causing the end to be sealed (Step 32). A rod is horizontally joined to the sealed

end of the deposited tube (Step 33). The rod-joined deposited tube is separated from the lathe, and then fed to the tube shrinking/closing lathe shown in [Fig. 3] Fig. 2. In the tube shrinking/closing lathe, the deposited tube is then vertically arranged in such a fashion that it extends vertically through the circular heater while the rod is upwardly directed (Step 34). Subsequently, the circular heater is moved to the joint between the deposited tube and rod. The heating temperature of the circular heater is then adjusted so that it is lower than the softening point of the deposited tube. In this state, the circular heater is upwardly and downwardly moved at a low speed to heat the deposited tube. The chlorine gas injector supplies chlorine gas to the deposited tube through the lower support member of the lathe in order to remove moisture existing in the deposited tube. At the same time, the vacuum exhaust value is opened to remove contaminants, including moisture, from the interior of the deposited tube (Step 36).

IN THE CLAIMS

Please delete claims 1-8 and 14-17 without prejudice and disclaimer, amend claims 9 through 13, 18, 22, 24 and 25, and add new claims 26 through 33, as follows:

9. (Amended) A method for manufacturing an [An] optical fiber preform [manufacturing method], comprising the steps of:

depositing a clad layer and a core layer on an inner surface of a preform tube, thereby

forming a deposited tube;

shrinking one end of the deposited tube, thereby sealing the one end of the deposited tube;

arranging the deposited tube in such a fashion that it extends vertically through a circular heater;

moving the circular heater to [the sealed] said one end of the deposited tube, and then adjusting a heating temperature of the circular heater to be not lower than a softening point of the deposited tube; and

shrinking and closing the deposited tube by heating the deposited tube while moving the circular heater at a desired speed[, thereby shrinking and closing the deposited tube].

10.(Amended) The [optical fiber preform manufacturing] method according to claim 9, further comprising the [steps] step of:

[moving the circular heater to the sealed end of the deposited tube, and then adjusting the heating temperature of the circular heater to be lower than a softening point of the deposited tube; and

heating the deposited tube while moving the circular heater at a desired speed, thereby exhausting contaminants existing in the interior of the deposited tube.]

after the arranging step, removing a contaminant existing in an interior of the deposited tube.

11.(Amended) The [optical fiber preform manufacturing] method according to claim 9, wherein the shrinking and closing step is carried out under the condition in which the deposited tube

rotates [at a desired speed] around its cylindrical axis, and [the] an interior of the deposited tube is maintained at a negative pressure.

12.(Amended) The [optical fiber preform manufacturing] method according to claim 9, wherein the circular heater is a furnace, and inert gas is supplied to the furnace to prevent an oxidation of the furnace at a heat generating region.

13.(Amended) The [optical fiber preform manufacturing] method according to claim 9, wherein the shrinking and closing step further comprises the step of removing a moisture in an interior of the deposited tube[is carried out under the condition in which chlorine gas is supplied to the interior of the deposited tube, thereby removing moisture generated in the interior of the deposited tube due to heat of the circular heater].

18.(amended) A method for manufacturing an optical fiber preform, comprising the steps of:

preparing a deposited tube by depositing a clad layer and a core layer on [the inside] an inner surface of a horizontally arranged preform tube;

sealing one end of the deposited tube;

attaching a rod to said one end of the deposited tube;

arranging the rod-joined deposited tube vertically [with the sealed end up] and arranging a circular heater around the tube;

removing a contaminant from an interior of the deposited tube;

[adjusting the temperature of the circular heater to a temperature lower than the softening point of the deposited tube;

moving the circular heater down and up over the length of the deposited tube while evacuating the deposited tube with a vacuum pump;]

[then,] placing the circular heater above [the sealed] said one end of the deposited tube and adjusting [the] a temperature of the circular heater to a temperature not lower than [the] a softening point of the deposited tube and maintaining this temperature until the temperature is stabilized;

applying negative pressure to the interior of the deposited tube using [the] a vacuum pump; and

shrinking the deposited tube [by] while rotating the deposited tube [while] and moving the circular heater [downward over] from said one end to an unsealed end of the deposited tube simultaneously with the applying step.

22.(Amended) The method of claim 18, [further comprising the step of:

using a furnace as] wherein the circular heater comprises a furnace.

24.(Amended) The method of claim 18, [said step of arranging the deposited tube further comprising] wherein the removing step further comprises the steps of:

[attaching a rod to the sealed end of the deposited tube; and

mounting the deposited tube in a vertical lathe with the rod held by an upper support member

of the vertical lathe.]

moving the circular heater to the one end of the deposited tube, and then adjusting the heating temperature of the circular heater to be lower than a softening point of the deposited tube; and

heating the deposited tube while moving the circular heater at a desired speed, thereby exhausting contaminants existing in the interior of the deposited tube.

25.(Amended) The method of claim 18, said step of [moving] shrinking the circular heater further comprising:

injecting chlorine gas into the deposited tube.

--26. A method for manufacturing an optical fiber preform, comprising the steps of:

depositing a clad layer and a core layer on an inner surface of a preform tube in a horizontal lathe, thereby forming a deposited tube;

shrinking one end of the deposited tube, thereby sealing the one end of the deposited tube;

attaching a rod to said one end of the deposited tube;

separating the deposited tube attached to said rod from said horizontal lathe;

mounting the deposited tube attached to said rod in a vertical lathe in such a fashion that it extends vertically through a circular heater;

placing the circular heater around said one end of the deposited tube;

setting a heating temperature of the circular heater to a first heating temperature which is not lower than the softening point of the deposited tube;

heating the deposited tube while moving the circular heater with said first heating temperature from said one end of the deposited tube to an unsealed end of the deposited tube at a desired speed while applying negative pressure to a hollow of the deposited tube;

moving the circular heater from said unsealed end to said one end of the deposited tube;

setting a heating temperature of the circular heater to a second heating temperature which is lower than the softening point of the deposited tube;

maintaining said temperature until said temperature is stabilized; and

shrinking the deposited tube by moving the circular heater with said second heating temperature from said one end to said unsealed end of the deposited tube at a desired speed while applying negative pressure to said hollow of the deposited tube.

--27. The method according to claim 26, wherein the desired speed in the heating step is in the range of 20 to 40 mm/min.

--28. The method according to claim 26, further comprising the step of removing moisture generated in the interior of the deposited tube due to heat of the circular heater.

--29. The method according to claim 28, wherein the step of removing moisture further comprises the step of supplying chlorine gas to said hollow of the deposited tube.

--30. The method according to claim 26, further comprising the step of rotating the deposited

tube about its cylindrical axis simultaneously with the step of shrinking.

--31. The method according to claim 26, further comprising the step of:

repeating the step of shrinking.

--32. The method according to claim 10, wherein the step of removing further comprises the steps of:

placing the circular heater to the one end of the deposited tube, and then adjusting the heating temperature of the circular heater to be lower than the softening point of the deposited tube; and

heating the deposited tube while moving the circular heater at a desired speed, thereby exhausting contaminants existing in the interior of the deposited tube.

--33. The method according to claim 13, wherein the step of removing a moisture further comprises the step of supplying chlorine gas to the interior of the deposited tube.